

Iluka Resources Ltd.

**Cloverdale Project**

Vegetation, Flora and Fauna  
Investigations

Report

April 2005



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# 1. Introduction

## 1.1 Background

Iluka Resources proposes to establish a mineral sands mine in the Tutunup area, called the Cloverdale Mineral Sands Project. The Cloverdale Project Area is sited approximately 8 kilometres south of Capel and 20 km east of Busselton, in the Shires of Busselton and Capel. The study area is shown in Figure 1. The deposit forms a significant mineral sands resource approximately 4 km in length, running from the Capel – Donnybrook Road in the north and heading southwest.

With the exception of a very small area of Vacant Crown Land on the Ludlow River, the Project is located on private property on the Swan Coastal Plain. It is predominantly cleared for agriculture. Remnant vegetation consists of road reserves, isolated trees in paddocks and small areas of vegetation, often along drainage channels, including the Ludlow River. A State Forest is located approximately 4 km southwest of the Project Area.

## 1.2 Scope of Work

GHD's environmental specialists have undertaken the following scope of works:

- » Review of Preliminary Ecological Assessment conducted by Hart, Simpson and Associates in 2001.
- » Review of CALM rare flora and threatened fauna information and DoE wetland information. Maps generated from the CALM and DoE databases showing locations of rare and priority flora, TECs and classified wetlands have been provided by Iluka.
- » Undertake field survey – identifying potential fauna habitats, mapping vegetation areas, identifying any priority/declared rare flora, threatened fauna or threatened ecological communities. The presence of wetlands was assessed. All vegetated areas were assessed using the Bush Forever (2000) Vegetation Condition Rating scale.
- » A review of the significance of vegetation sites and any priority or threatened species identified in local and regional context.
- » A review of the impacts of Iluka's proposed clearing on the vegetation sites and flora and fauna species in local and regional context.

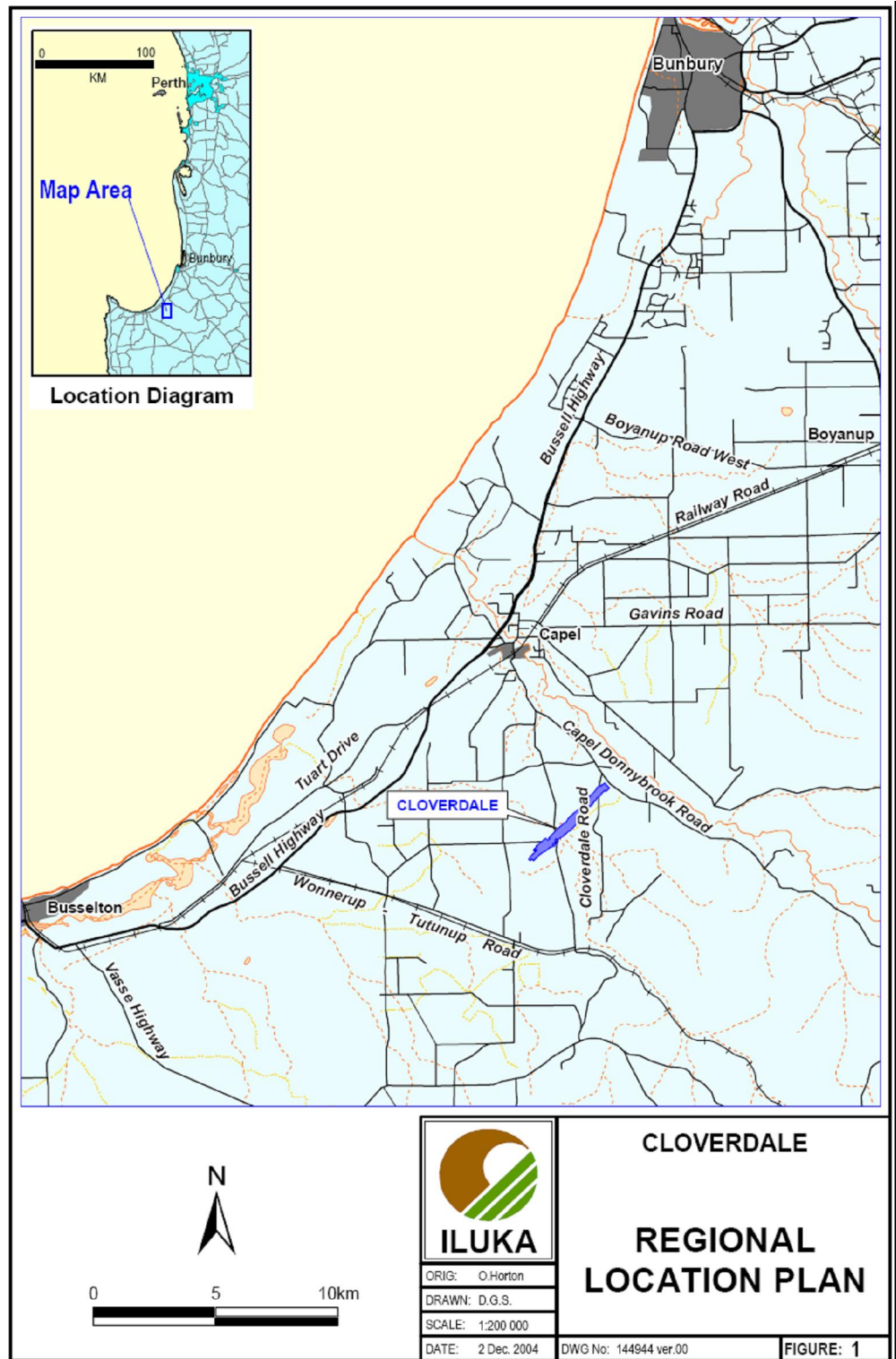


Figure 1: Cloverdale Prospect Location Plan



## 2. Existing Environment – Desktop Assessment

Previous studies of the project area have been completed. These include:

- » Hart, Simpson and Associates (2001) Tutunup West: Ecological Review prepared for Iluka Resources Ltd, October 2001.
- » Mattiske Consulting Pty Ltd (2003). Flora and Vegetation on Yoganup West Survey Area, prepared for Iluka Resources Ltd, January 2003; and
- » GHD Pty Ltd (2004). Pre-Mining Flora Survey - Yoganup Extended Remnants Mine, prepared for Iluka Resources Ltd, August 2004.

### 2.1 Wetlands

Much of the Study Area is recorded as palusplain – seasonally waterlogged lands.

WALIS stores the most recent updates of the status of wetlands across the Swan Coastal Plain. A number of small multiple use sumplands and damplands are recorded by WALIS across the Project Area, including:

- » Sumplands: 848, 824, 828, 829, 879, 834, 817
- » Damplands: 867, 823, 849, 784.

One Resource Enhancement Wetland (REW) (#671) is located on the far west of the Study Area boundary approximately 2 km west of the orebody, beyond the 1000 m Buffer delineated by HM Resources.

One gazetted Conservation Category Wetland (#826) occurs within the Cloverdale Project Vegetation Flora and Fauna Study Area (the Study Area). The wetland boundary follows the Vacant Crown Land boundary along the Ludlow River, immediately west of Warnes/Armstrong Road. The wetland is downstream of the projected orebody.

Two rivers cross the study area. Capel River crosses at the northern boundary, flowing east-west. This river was flowing at the time of survey (late March 2005). Ludlow River crosses the middle of the survey area. Ludlow River was not flowing at the time of survey. Both rivers have quite degraded riparian zones due to long-term adjacent agricultural practices.

Wetlands were not assessed for their condition or status in this study.

### 2.2 Vegetation

#### 2.2.1 Regional Vegetation Communities

The survey area crosses a small portion of the southern Swan Coastal Plain. The *Vegetation Survey of Western Australia* series undertaken by Beard, does not cover the survey area. Using online tools – WALIS (Western Australian Land Information System) and ANRA (Australian Natural Resources Atlas) delimiting Pre-European



Vegetation Extents, the following vegetation communities are intersected by the survey area (Table 1).

**Table 1 Vegetation Communities intersected by the Cloverdale Project.**

<b>Vegetation Community</b>	<b>Source</b>
Melaleuca shrubland in mosaic Jarrah woodland	WALIS
Eucalyptus low open forest	ANRA
Eucalyptus and Allocasuarina woodland	ANRA

No Beard Vegetation Codes match such descriptions given by WALIS or ANRA.

Mattiske Consulting Pty Ltd (2003) was commissioned by Iluka Resources Ltd to undertake an assessment of the botanical values on the Yoganup West lease area near the Ludlow River and Tiger Gully, situated to the east of the Cloverdale Project Area. Mattiske (2003) mapped a total of 9 vegetation communities, all of which may be applicable to this Project Area:

- » Tall open woodland of *Corymbia calophylla* with the occasional *Agonis flexuosa* on the Ludlow River;
- » Open woodland of *Corymbia calophylla* – *Melaleuca raphiophylla* on the Ludlow River;
- » Low open woodland of *Melaleuca raphiophylla* over pastures on the flats away from the watercourses;
- » Low woodland of *Corymbia calophylla* – *Agonis flexuosa* with the occasional *Nuytsia floribunda* on the small sandy rises;
- » Woodland of *Corymbia calophylla* with the occasional *Eucalyptus marginata* subsp. *marginata* over *Kingia australis* on lower slopes;
- » Open woodland of *Banksia attenuata* – *Banksia ilicifolia* – *Xylomelum occidentale* with the occasional *Eucalyptus marginata* subsp. *marginata* on small-elevated sand dunes;
- » Low open woodland of *Melaleuca preissiana* on the low-lying seasonally wetter fringes of the *Banksia* woodlands;
- » Low open woodland of *Melaleuca cuticularis* on the open pasture areas; and
- » Open pasture areas with occasional tree of *Melaleuca raphiophylla* and *Corymbia calophylla*.

### **2.2.2 Vegetation Condition**

The vegetation at the study sites (see Section 3) was given a condition rating based on the Bush Forever Condition Rating Scale (Government of WA, 2000). The ratings in this scale are described as follows:



1. Pristine or nearly so.
2. Vegetation structure intact, disturbance affecting individual species, and weeds are non-aggressive species.
3. Vegetation structure altered, obvious signs of disturbance.
4. Vegetation structure significantly altered by very obvious signs of multiple disturbance, retains basic vegetation structure or ability to regenerate it.
5. Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.
6. The structure of the vegetation is no longer intact and the area is completely or almost without native species.

Vegetation Condition Rating for sites examined are recorded in Table 6.

### **2.3 Regional Significance of the Vegetation**

A vegetation type is considered to be under-represented if there is less than 30 percent of its original distribution remaining. Native vegetation types represented in the study area, their regional extent and reservation status are generally drawn from Shepherd *et al* (2002).

As a result of the lack of discrete Beard Code identification for the Pre-European Vegetation description, no extent or conservation status can be delineated from a desktop assessment.

### **2.4 Threatened Ecological Communities**

Ecological communities are defined as 'naturally occurring biological assemblages that occur in a particular type of habitat' (English and Blythe, 1997). Threatened Ecological Communities (TECs) are ecological communities that have been assessed and assigned to one of four categories related to the status of the threat to the community, i.e. Presumed Totally Destroyed, Critically Endangered, Endangered, and Vulnerable. Some TECs are protected under the Commonwealth *Environmental Protection and Biodiversity Act, 1999 (EPBC Act)*. Although TECs are not formally protected under the State *Wildlife Conservation Act 1950*, the loss of, or disturbance to, some TECs trigger the EPBC Act. The Environmental Protection Authority's position on TECs states that proposals that result in the direct loss of TECs are likely to be formally assessed.

A search of the Department of Conservation and Land Management (CALM) TEC Database was conducted and revealed that there are no known occurrences of TECs within a search area surrounding the Cloverdale Prospect. However, a suite of five TECs occur in the general Capel area, and these are summarised below (Table 2).





**Table 2 Threatened Ecological Communities found in the general Capel area**

SCP Community Type	General Description	Status (EPBC Act Category)
10b	Shrublands of southern Swan Coastal Plain Ironstones (Busselton area)	Critically Endangered (EN)
2	Southern wet shrublands, Swan Coastal Plain	Endangered
3a	<i>Corymbia calophylla</i> – <i>Kingia australis</i> woodlands on heavy soils, Swan Coastal Plain	Critically endangered (EN)
1b	<i>Corymbia calophylla</i> woodlands on heavy soils of the southern Swan Coastal Plain	Vulnerable
7	Herb rich saline shrublands in clay pans	Vulnerable

TECs have been assigned a status of threat, as detailed below:

- » Critically Endangered – An ecological community which has been adequately surveyed and found to have been subject to a major contraction in area and/or which was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.
- » Endangered – An ecological community which has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.
- » Vulnerable – An ecological community which has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community which is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

Communities 10b and 3a are also listed as endangered under the *Commonwealth Environmental Protection and Biodiversity Conservation Act (1999)*.

## 2.5 Flora

The Department of Conservation and Land Management's (CALM) records indicate that the following Declared Rare and Priority flora are known to exist within the general Cloverdale Project Area (Table 3).



**Table 3 Declared Rare and Priority Flora known from general Capel area**

<b>Taxon (species or subspecies)</b>	<b>Conservation Code (CALM)</b>	<b>Description</b>	<b>Preferred Habitat</b>	<b>Known Localities</b>	<b>Likely Observance (March 2005)</b>
<i>Acacia flagelliformis</i>	P4	Rush-like, erect or sprawling shrub, 0.3–0.75(–1.6) m high. Fl. yellow, May–Sep.	Sandy soils. Winter-wet areas.	Harvey, Eaton, Bunbury, Capel, Busselton, Donnybrook	Yes – not flowering
<i>Amperea micrantha</i>	P2	Low, spreading, bushy perennial, herb, 0.1–0.3 m high. Fl. brown, Oct–Nov.	Sandy soils.	Mokine, Yoongarillup, Busselton, Capel, Whicher Range, Ruabon NR	Yes – not flowering
<i>Andersonia ferricola</i>	P1	Shrub, 0.2–0.5 m high. Fl. purple, Oct.	White sand or red-brown loam over ironstone. Seasonally wet flats	Whicher Range	Possibly – not flowering
<i>Anthotium junciforme</i>	P4	Open, erect to prostrate perennial, herb, 0.05–0.4 m high, leaves linear to terete, 0.5–1 mm wide; flowering stems 12–40 cm long. Fl. blue, violet, purple, Nov–Mar.	Sandy clay, clay. Winter-wet depressions, drainage lines.	Wattle Grove, Midland, Bayswater, Serpentine, Upper Swan, Kenwick, Busselton, Scott River Plain, Albany	Yes
<i>Aponogeton hexatepalus</i>	P4	Rhizomatous or cormous, aquatic perennial, herb, leaves floating. Fl. green, white, Jul–Oct.	Mud. Freshwater: ponds, rivers, claypans.	Perth, Pinjarra, Capel, Bunbury, Boyanup, Nannup	No – Drainage lines dry (non-perennial)
<i>Banksia meisneri</i> subsp <i>ascendens</i>	P4	Shrub, 0.5–2 m high, leaves ascending, 8–15 mm long. Fl. yellow, orange, brown, Apr–Sep.	White or grey sand. Swampy flats.	Ruabon, Scott River, Gingilup Swamp	Possibly – Not flowering
<i>Blennospora doliiformis</i>	P3	Erect annual, herb, to 0.15 m high. Fl. yellow, Oct–Nov.	Grey or red clay soils over ironstone. Seasonally-wet flats.	Ruabon, Yalgorup, Lake Muckenburra, Kooljerrenup NR, Busselton, Austin Bay NR	No – Not flowering, annual plant
<i>Boronia anceps</i>	P3	Perennial, herb, 0.3–0.6 m high, lacking lignotuber, stem flattened and ancipitous when young. Fl. pink, purple, Sep–Jan.	White sand, gravelly laterite. Seasonally swampy heaths.	Scott River, Walpole, Cape Naturaliste, Cowaramup	Yes – not flowering



Taxon (species or subspecies)	Conservation Code (CALM)	Description	Preferred Habitat	Known Localities	Likely Observance (March 2005)
<i>Boronia humifusa</i>	P1	Low-growing, wiry perennial, herb, 0.1–0.2 m high. Fl. pink, red, Jun/Sep.	Gravelly clay loam over laterite. Jarrah-marri open forest.	Capel, Tutunup	Yes – not flowering
<i>Boronia tetragona</i>	P3	Perennial, herb, 0.3–0.7 m high, leaves sessile, entire, with papillate margins, branches quadrangular, sepals ciliate. Fl. pink, red, Oct–Dec.	Black/white sand, laterite, brown sandy loam. Winter-wet flats, swamps, open woodland.	Capel, Busselton, Whicher Range, Cowaramup	Yes – not flowering
<i>Brachyscias verecundus</i>	DRF	Annual (or ephemeral), herb, 0.012–0.022 m high, entirely glabrous. Fl. white, cream.	In a moss sward. On a granite outcrop.	Busselton	No – annual plant
<i>Caladenia busselliana</i>	DRF	Tuberous, perennial, herb, 0.2–0.3 m high. Fl. green, yellow, cream, Sep–Oct.	Sandy loam. Winter-wet swamps.	Marybrook, Capel	No – annual
<i>Caladenia huegelii</i>	DRF	Tuberous, perennial, herb, 0.25–0.6 m high. Fl. green, cream, red, Sep–Oct.	Grey or brown sand, clay loam.	Perth-Capel	No – annual
<i>Chamaescilla gibsonii</i>	P3	Clumped tuberous, herb. Fl. blue, Sep.	Clay to sandy clay. Winter-wet flats, shallow water-filled claypans.	Ellen Brook, Yule Brook, Mogumber, Muchea, Drakesbrook, Capel, Brunswick Jun	No – annual
<i>Chamelaucium roycei</i> ms	DRF	Bushy shrub, 0.3–1.5 m high. Fl. white, pink, Aug–Dec.	Sandy clay, clay, lateritic soils. Winter-wet flats, swamps, stream banks.	Capel	Yes – not flowering
<i>Chordifex gracilior</i>	P3	Rhizomatous, erect perennial, herb, 0.3–0.5 m high. Fl. brown, Sep–Dec.	Peaty sand. Swamps.	S of Busselton, Yoongarillup, Scott River, Mt Wells, NW of Mt Barker, Denbarker	No – annual plant, not flowering
<i>Dryandra nivea</i> subsp <i>uliginosa</i>	DRF	Dense, erect, non-lignotuberous shrub, 0.2–1.5 m high. Fl. yellow, brown, Aug–Sep.	Sandy clay, gravel.	Whicher Range, Scott River, Tutunup	Yes – not flowering



Taxon (species or subspecies)	Conservation Code (CALM)	Description	Preferred Habitat	Known Localities	Likely Observance (March 2005)
<i>Dryandra squarrosa</i> subsp <i>argillacea</i>	DRF	Erect, open, non-lignotuberous shrub, 1.2–4 m high. Fl. yellow, Jun–Nov.	White/grey sand, gravelly clay or loam. Winter-wet flats, clay flats.	Ruabon, Tutunup, Whicher Range	Yes – not flowering
<i>Eremaea blackwelliana</i>	P4	Erect shrub, 1–3 m high, to 3 m wide. Fl. orange, Sep–Nov.	White sand. Sandy depressions, gentle hillside.	Clackline, Hoddy Well	Yes – not flowering
<i>Franklandia triaristata</i>	P4	Erect, lignotuberous shrub, 0.2–1 m high. Fl. white, cream, yellow, brown, purple, Aug–Oct.	White or grey sand.	Capel, Tutunup, Jarrahwood, Argyle	Yes – not flowering
<i>Grevillea elongata</i>	DRF	Shrub, 1.5–2 m high. Fl. white, cream, Oct.	Gravelly clay, sandy clay, sand. Road verges, swamps, creek banks.	Ruabon, Abba SF, Whicher Range, Butler SF	Yes – not flowering
<i>Grevillea maccutcheonii</i>	DRF	Densely branched shrub, to 2 m high. Fl. green, red, Mar–May/Dec.	Shallow soils over laterite, clay. Seasonally inundated sites.	Tutunup	Possibly
<i>Grevillea manglesioides</i> subsp <i>ferricola</i>	P2	Erect or spreading shrub, 1.5 m high. Fl. red, green, Oct.	Red sandy clay over ironstone. Winter wet flats.	Scott River	Yes – not flowering
<i>Hakea oldfieldii</i>	P3	Open, straggling shrub, up to 2.5 m high. Fl. white, cream, yellow, Aug–Oct.	Red clay or sand over laterite. Seasonally wet flats.	Katanning, Champion Bay, Busselton, Stirling Range, Whicher Range, Woogenilup, Treeton	Yes – not flowering
<i>Haloragis tenuifolia</i>	P3	Erect or prostrate annual, herb, 0.05–0.5 m high. Fl. brown, red, Sep–Dec.	Grey sand, clay. Winter wet flats.	Ruabon, Maddington, Harvey, Pinjarra, Upper Swan, Gingin, Cooljarloo, (Woorooloo, Midland, Byfields Mill)	No – annual plant, not flowering



Taxon (species or subspecies)	Conservation Code (CALM)	Description	Preferred Habitat	Known Localities	Likely Observance (March 2005)
<i>Isopogon formosus</i> subsp <i>dasylepis</i>	P3	Low, bushy or slender, upright, non-lignotuberous shrub, 0.2–2 m high. Fl. pink, purple, red, Jun–Dec.	Sand, sandy clay, gravelly sandy soils over laterite. Often swampy areas.	Capel, Ludlow, Busselton, Ruabon, Scott River, Yoongarillup	Yes – not flowering
<i>Jacksonia sparsa</i> ms	P4	Erect & slender shrub, 1–3 m high. Fl. yellow, orange, red, Sep–Feb.	White or grey sand.	Whicher Range, Bunbury, Capel, Harvey, Pemberton, Boyanup, Dandalup, Nannup, Lake Clifton	Yes – not flowering
<i>Lasiopetalum membranaceum</i>	P3	Multi-stemmed shrub, 0.2–1 m high. Fl. pink, blue, purple, Sep–Dec.	Sand over limestone	Yalgorup, Capel, Dwellingup, Yandup, Australind, Dawesville, Yanchep	Not likely
<i>Loxocarya magna</i>	P3	Rhizomatous, perennial, herb (sedge-like), 0.5–1.5 m high. Fl. Sep–Nov.	Sand, loam, clay, ironstone. Seasonally inundated or damp habitats.	Scott River, Ruabon, Whicher, Fish Road, Treeton, Carbunup, Tutunup	Yes – Not flowering
<i>Mitreola minima</i>	P2	Slender, erect annual, herb, 0.025–0.04 m high. Fl. white, Oct–Dec.	Grey sand. Peaty swampy areas.	Woolbernup Hill, Walpole, Capel	No – annual plant, not flowering
<i>Petrophile latericola</i> ms	DRF	Multi-stemmed shrub, 0.4–1.5 m high. Fl. yellow, Nov.	Red lateritic clay. Winter-wet flats.	Ruabon, Williamson	Yes – not flowering
<i>Rhodanthe pyrethrum</i>	P3	Erect, slender annual, herb, 0.05–0.2 m high. Fl. white, yellow, Oct–Dec.	Clay, sandy clay. Winter-wet depressions, clay pans, swamps.	Bullsbrook, Boyanup, Kenwick, Waterloo, Harvey, Eaton, Denmark	No – annual plant, not flowering
<i>Schoenus natans</i>	P4	Aquatic annual, grass-like or herb (sedge), 0.3 m high. Fl. brown, Oct.	Winter-wet depressions.	Pinjarra, (Cannington), Lake Muckenburra, Gingin, Busselton, Beaufort River, West Dale, Lake Muir	Yes – not flowering
<i>Stylidium leeuwinense</i>	P3	Erect perennial, herb, to 0.45 m high, leaves adpressed, tile-like, spiral, lacking mucro. Fl. red, purple, Feb–May.	Black sandy soil. Swampy heathland.	Capel, Scott River, Milyeannup, Shannon River, Walpole-Nornalup NP, Quarram, Northcliffe	No – annual plant, not flowering



Taxon (species or subspecies)	Conservation Code (CALM)	Description	Preferred Habitat	Known Localities	Likely Observance (March 2005)
<i>Synaphea hians</i>	P3	Prostrate or decumbent shrub, 0.15–0.6 m high, to 1 m wide. Fl. yellow, Jul–Nov.	Sandy soils. Rises.	Busselton, Collie, Ludlow, Capel	Yes – not flowering
<i>Tetradlea parvifolia</i>	P3	Small shrub, 0.2–0.3 m high. Fl. pink, Oct		Capel, East of Donnybrook, Collie	Yes – not flowering
<i>Trichocline</i> sp. Treeton	P2	Tuberous, perennial, herb, to 1.6 m high.	Sand over limestone, sandy clay over ironstone. Seasonally wet flats	Treeton, Meelon	Not Likely – unsuitable soil conditions present
<i>Tripterococcus brachylobus</i> ms	P4	Perennial, herb, to 1 m high. Fl. yellow, green, Nov–Feb.	Grey sand, red clay, laterite, often moist. Low-lying flats.	Margaret River, Scott River, Walpole, Crystal Springs, Gingilup	No – annual plant, not flowering
<i>Verticordia attenuata</i>	P3	Shrub, 0.4–1 m high. Fl. pink, Dec–May.	White or grey sand. Winter-wet depressions.	Ruabon - Tutunup (Busselton), Bunbury, Capel	Yes
<i>Verticordia densiflora</i> var. <i>pedunculata</i>	DRF	Erect to spreading shrub, 0.3–0.6 m high. Fl. pink, white, Dec–Jan.	Grey/yellow sand, sandy loam. Winter-wet low-lying areas.	Busselton, Perup, Ruabon, Manjimup	Yes – not flowering
<i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>	P4	Erect shrub, 0.2–0.75 m high. Fl. pink, May/Nov–Jan.	Sand, sandy clay. Winter-wet depressions.	Gillingarra-Forrestdale, Cannington, Guildford, Muchea, Gingin, Murray River, Moore River	Yes – not flowering
<i>Verticordia plumosa</i> var. <i>vassensis</i>	DRF	Shrub, 0.3–1 m high. Fl. pink, Sep–Feb.	White/grey sand. Winter-wet flats.	Ambergate, Ruabon, Tutunup	Yes – not flowering
<i>Villarsia submersa</i>	P4	Aquatic, extremely slender perennial, herb. Fl. white, Aug–Nov.	In freshwater 0.05–0.6 m deep. Pools, lakes, swamps, winter-wet depressions, claypans.	Gunapin, Boyanup, Lake Muir, Denmark, Forrestdale, Kenwick, Frankland River, Lane Poole	Possibly – few instances of standing or flowing water present



These taxa are assigned a code of conservation significance by CALM, described in Table 4.

**Table 4 Conservation Codes and Descriptions for CALM Declared Rare and Priority Flora Species.**

Conservation Code	Description
R: Declared Rare Flora – Extant Taxa	Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.
1: Priority One – Poorly Known Taxa	Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
2: Priority Two – Poorly Known Taxa	Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
3: Priority Three – Poorly Known Taxa	Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey.
4: Priority Four – Taxa in need of monitoring	Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5 – 10 years.
5: Priority Five – Taxa in need of monitoring	Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors, but are dependent on conservation efforts to reduce threats. These taxa require monitoring every 5 – 10 years.



## 2.6 Fauna

### 2.6.1 Expected Fauna

A search of the Western Australian Museum's FaunaBase web based programme revealed that 1 mammal species and 2 reptile species have been recorded from the vicinity of the Cloverdale Prospect (Appendix B).

A previous fauna habitat survey undertaken by Ninox (2003) at the nearby Yoganup West Mine Site recorded 23 species of birds and 4 mammal species.

### 2.6.2 Significant Fauna

The conservation status of fauna species is assessed under State and Commonwealth Acts; in particular the *Western Australian Wildlife Conservation Act 1950*; *Wildlife Conservation (Specially Protected Fauna) Notice 2003*, and the *Commonwealth Environmental Protection and Biodiversity Conservation (EPBC) Act 1999*.

The significance levels for fauna used in the *EPBC Act* are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN).

Fauna species that are listed as 'Vulnerable' under the *EPBC Act* will trigger referral to the Act in the following circumstances:

When an action has, will have, or is likely to have a significant impact on a Vulnerable species if it does, will, or is likely to:

- » lead to a long-term decrease in the size of an important population of a species, or
- » reduce the area of occupancy of an important population, or
- » fragment an existing important population into two or more populations, or
- » adversely affect habitat critical to the survival of a species, or
- » disrupt the breeding cycle of an important population, or
- » modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is also likely to decline, or
- » result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat\*, or
- » interferes substantially with the recovery of the species.

An important population is one that is necessary for a species' long-term survival and recovery. This may include populations that are:

- » key source populations either for breeding or dispersal,
- » populations that are necessary for maintaining genetic diversity, and/or
- » populations that are near the limit of the species range.





*\*Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a vulnerable species by direct competition, modification of habitat, or predation.*

The EPBC Act also has lists of migratory species that are recognised under international treaties such as the China Australia Migratory Bird Agreement (CAMBA), the Japan Australia Migratory Bird Agreement (JAMBA) and the Bonn Convention (The Convention on the Conservation of Migratory Species of Wild Animals).

Listed migratory species also include any native species identified in an international agreement approved by the Commonwealth Environment Minister. The Minister may approve an international agreement for this purpose if satisfied that it is an agreement relevant to the conservation of migratory species.

In Western Australia, the Department of Conservation and Land Management (CALM) has significant levels for fauna classified in a series of Schedules (Appendix B). CALM also produces a supplementary list of Priority Fauna, being species that are not considered Threatened under the Western Australian Wildlife Conservation Act but for which the Department feels there is a cause for concern. These species have no special protection, but their presence would normally be considered. The taxon needs further survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna. Levels of Priority are described in Appendix B.

A listing of Significant Fauna from the EPBC Act Protected Matters Search Tool and Rare and Priority species from the Department of Conservation and Land Management (CALM) rare fauna database which may occur in the Cloverdale Prospect area was obtained (Table 5). The likelihood that these fauna may be present at the Prospect is considered in greater detail below.

### **2.6.3 Likelihood of Significant Fauna**

#### **Chuditch**

The Chuditch may be present in the area as an occasional vagrant, but likely to be in the more heavily wooded areas on the Whicher and Darling Scarps above the project area. The Chuditch occupies large home ranges, is highly mobile and appears able to utilise bush remnants and corridors.

The Chuditch was formerly very widespread in a range of habitats, but is now virtually restricted to forest areas where it occurs widely but at low densities due to the large home range of individuals. The Chuditch has responded well to fox control. It is not considered likely to be present in the study area, where competition from Foxes is known to occur.

#### **Western Ringtail Possum**

This species occurs in areas of forest and dense woodlands and requires tree hollows and/or dense canopy for refuge and nesting. This species has been recorded in the CALM search area in the past, and may still be present.



### **Black Cockatoo species**

Both Baudin's and Carnaby's Black Cockatoos will almost certainly occur on occasions when marri nuts are available as a food resource. There are also areas of proteaceous species, which are also a food resource. Carnaby's are unlikely to breed in the area as the currently known breeding range for these birds occurs to the north of the project area. Ninox (2003) describes that the Yoganup West area immediately to the east of the Cloverdale Project area is within the known breeding range of the Baudin's Black Cockatoo, but the presence of suitable nesting hollows is uncertain. Large marri trees are the favoured nesting tree for this species, and scattered suitable plants, although not recorded, may be present in the area.

Black Cockatoos tend to congregate in flocks closer to the coast and the Perth metropolitan area during the non-breeding season but disperses into the wheatbelt (Carnaby's) or Darling Forest (Baudin's) in winter through to early summer to nest. Black Cockatoo relies on two very different habitats or vegetation types during the nesting season for hollows and food. They breed in the hollows of mature eucalypt trees, particularly salmon gum and wandoo (white gum). Traditionally it has fed on kwongan heath plants such as banksias, grevilleas, hakeas and dryandra. They also feeds on marri seeds and has adapted to feeding on introduced species such as pines and Cape Lilac (*Melia azedarach*) trees, and weeds such as wild radish (*Raphanus raphanistrum*) and wild geranium (*Erodium* spp.).

### **Phascogale**

This arboreal marsupial occurs in forest and woodland with suitable tree hollows. Populations fluctuate dramatically in response to invertebrate prey abundance. Ninox (2003) states "Although not confirmed, scats that could be attributed to this species were located in the corridor of vegetation running east from Cloverdale Road." This site is on the eastern boundary of the Cloverdale Project area. It is considered likely that that species is present in the Study Area.

### **Rakali (Water Rat)**

This species has been recorded from Ludlow – where it supports main prey items such as molluscs and crustaceans. Considering that the Ludlow River was dry at the time of survey, this species is considered to be limited to the currently wet Capel River, until favourable conditions extend this species' range.

### **Quenda**

This species prefers areas with dense understorey vegetation, particularly around swamps and along watercourses. It is likely to occur in the project area. However, the presence of observed Red Foxes may limit the abundance of this species in the project area.

### **Quokka**

This species is considered unlikely, but may occur in the Project Area, with the mainland quokka mostly living in the Darling Range and south-west regions of Western Australia, inhabiting densely vegetated swamps and sometimes tea-tree thickets on sandy soils along creek systems and dense heath on slopes.



### **Migratory Species**

The migratory bird species likely to occur in the area are listed below. Migratory bird species protected under the JAMBA/CAMBA Treaty may potentially occur seasonally in the vicinity of the Cloverdale Project Area.



**Table 5 Listing of Potentially Occurring Significant, Rare and Priority Fauna Species – Cloverdale Prospect**

<b>Family</b>	<b>Genus</b>	<b>Species</b>	<b>Common Name</b>	<b>CALM Rating</b>	<b>EPBC Act Rating</b>
Dasyuridae	<i>Dasyurus</i>	<i>geoffroii</i>	Chuditch	Schedule 1	Vulnerable
Pseudocheiridae	<i>Pseudocheirus</i>	<i>occidentalis</i>	Western Ringtail Possum	Schedule 1	Vulnerable
Psittacidae	<i>Calyptorhynchus</i>	<i>baudinii</i>	Baudin's Black Cockatoo	Schedule 1	Vulnerable
Psittacidae	<i>Calyptorhynchus</i>	<i>latirostris</i>	Carnaby's Black Cockatoo	Schedule 1	Endangered
Dasyuridae	<i>Phascogale</i>	<i>tapoatafa tapoatafa</i>	Southern Brush-tailed Phascogale	Priority 3	
Muridae	<i>Hydromys</i>	<i>chrysogaster</i>	Rakali (Water Rat)	Priority 4	
Peramelidae	<i>Isoodon</i>	<i>obesulus fusciventor</i>	Quenda	Priority 5	
Macropodidae	<i>Setonix</i>	<i>brachyurus</i>	Quokka	Schedule 1	Vulnerable
Accipitridae	<i>Haliaeetus</i>	<i>leucogaster</i>	White-bellied Sea-eagle		Migratory
Hirundinidae	<i>Apus</i>	<i>pacificus</i>	Fork-tailed Swift		Migratory
Ardeidae	<i>Ardea</i>	<i>alba</i>	Great Egret, White Egret		Migratory
Ardeidae	<i>Ardea</i>	<i>ibis</i>	Cattle Egret		Migratory
Meropidae	<i>Merops</i>	<i>ornatus</i>	Rainbow Bee-eater		Migratory



### 3. Results of Field Survey

The field survey was conducted on the 21 and 22 March 2005. This survey recorded vegetation types and dominant species in each vegetation type. A list of species was generated for each vegetation type, with confirmations made at the West Australian State Herbarium. The presence of Declared Rare or Priority Flora was noted and commented upon. The condition and weed status of the vegetation were also noted.

A similar survey was conducted for the presence of fauna, and a consideration of fauna habitat was undertaken in the search area.

The vegetation communities, location of significant flora, and survey sites described as part of the survey are mapped in Appendix C.

#### **3.1 Vegetation**

The table below describes the vegetation communities and their condition rating for the Cloverdale Prospect area (Table 6).



**Table 6 Vegetation Community Description and Condition Rating, Cloverdale Prospect Area**

Site	Site Description	Vegetation Community Description	Vegetation Condition Rating
1	T Hutton - Western Reserve	Marri woodland with scattered Jarrah over <i>Agonis flexuosa</i> with scattered <i>Nuytsia</i> , <i>Allocasuarina humilis</i> and <i>Acacia pulchella</i>	3
2	T Hutton - Top Reserve	Marri, Jarrah open woodland over <i>Banksia</i> with scattered <i>Xylomelum</i> , <i>Nuytsia</i> , <i>Persoonia</i> , over mixed heath/scrubland.	2-3 (fire and <i>Phytophthora</i> impacted). Few weeds – fenced from stock
3	Capel River - VCL	Tall open woodland of <i>Corymbia calophylla</i> , with scattered <i>Eucalyptus rudis</i> over <i>Agonis flexuosa</i> , over a degraded understory dominated by bracken, <i>Lepidosperma</i> , and Kikuyu.	4
4	C Hutton – Paddock above Ludlow River	Mixed Low woodland of <i>Corymbia calophylla</i> and <i>Agonis flexuosa</i> , grading into <i>Melaleuca preissiana</i> , <i>Agonis</i> woodland with scattered Jarrah in damper areas.	4
5	Bibby – Warnes Rd Banksia	Open woodland of <i>Banksia attenuata</i> – <i>B. ilicifolia</i> – <i>Xylomelum occidentale</i> with the occasional Jarrah on elevated sand	2/3 (Road Reserve) 3-4 (Bibby) 5 (Norton)
6	Downs Rd – Road Reserve	Mixed Woodland of Marri, <i>Agonis flexuosa</i> , <i>Melaleuca preissiana</i> over <i>Xanthorrhoea preissii</i> and <i>Kingia australis</i>  One grove of <i>Agonis flexuosa</i> only in paddock on southern side	4
7	Capel-Tutunup Rd – Road Reserve	Open Woodland of Marri, <i>Agonis</i> , <i>Banksia</i> over <i>Xanthorrhoea preissii</i> over <i>Eragrostis curvula</i>	5
8	Ludlow River VCL	Mixed Open Woodland of <i>Corymbia calophylla</i> with occasional <i>Agonis flexuosa</i> , <i>Melaleuca preissiana</i> .  Mixed open woodland of Marri, with Jarrah, <i>Banksia</i> , <i>Agonis</i> , over <i>Jacksonia</i> , <i>Daviesia</i> , <i>Acacia</i> (north side Ludlow R)	3-4 (downstream Warnes Rd) 5 (upstream) 3-4 north of Ludlow R.
9	Scott – Degraded Paddock	Open woodland of Marri over <i>Melaleuca preissiana</i> , over <i>Xanthorrhoea preissii</i> , <i>Kingia australis</i> , <i>Dasypogon</i> , <i>Mesomelaena</i> , <i>Hypocalymma</i> .	4
10	Warnes Rd – North Road Reserve	Open woodland of Marri over <i>Melaleuca preissiana</i> , over <i>Xanthorrhoea preissii</i> , <i>Kingia australis</i> , <i>Dasypogon</i> , <i>Mesomelaena</i> , <i>Hypocalymma</i> .	4-5



Site	Site Description	Vegetation Community Description	Vegetation Condition Rating
11	Warnes Rd – South Road Reserve	Open woodland of <i>Banksia attenuata</i> – <i>B. ilicifolia</i> – <i>Xylomelum occidentale</i> with the occasional Jarrah on elevated sand, grading into Tall Shrubland of <i>Kunzea</i> in damper areas. Understorey is mixed scrubland	3 – 3/4 – relatively good scrub condition
12	Norton – Cloverdale Rd	Low woodland of <i>Corymbia calophylla</i> – <i>Agonis flexuosa</i> with occasional <i>Nuytsia floribunda</i> on small sandy rises. No understorey	5
13	Open Paddocks – Norton, Doyle, etc...	Open pasture areas with occasional tree of <i>Melaleuca preissiana</i> and <i>Corymbia calophylla</i>	6



### 3.2 Threatened Ecological Communities

No Threatened Ecological Communities were recorded during this survey.

A potentially degraded community of *Corymbia calophylla* – *Kingia australis* was recorded during this survey (Site 9). A spring survey will indicate which annual plant species are present at this site to determine its similarity to the known TEC SCP3a of Gibson *et al.* (1994).

### 3.3 Flora

All native plants and the most common weed species were surveyed and recorded over the study area. Plants that could not be confidently named in the field were collected, pressed and compared with Western Australian Herbarium specimens for formal identification. Collections of specimens that may have been Priority species were made to ensure their correct identification. Weed species were also collected to ensure correct identification and especially to check whether they were Declared Plant species.

Vegetation is largely denuded in the study area, modified by agricultural activities, fire, occasional mining and roadworks. A list of all taxa collected and identified is provided in Appendix A. A total of 131 taxa representing 42 families of flora were identified during the survey. The final list is likely to be a reasonable reflection of plant species present but does not include annual species due to the season (autumn) and lack of flowering material making it difficult to identify material to species level.

Combined with the Hart, Simpson and Associates (2001) report on the Tutunup West Deposit, the flora list is raised to 179 taxa representing 52 families. Most additions are annual plants, with 11 taxa orchid species, including the DRF *Caladenia huegelii*.

For ease of reporting, the flora list has been tabulated for each site examined (Appendix A).

The families that had the most representation in Cloverdale Prospect area were:

» Proteaceae (Hakeas, Banksias):	18 taxa
» Myrtaceae (Melaleuca, Eucalyptus):	17 taxa
» Papilionaceae (peas):	13 taxa
» Poaceae (grasses):	12 taxa
» Cyperaceae (sedges):	11 taxa
» Orchidaceae (orchids):	11 taxa

*Acacia* species were the most dominant genera across the study area with 6 species observed. *Hibbertia* and *Hakea* were the next most dominant with 5 taxa, and *Melaleuca* (4 species), *Jacksonia* (4 species) and *Banksia* (4 species) also dominant.





### 3.3.1 Sites

Of the 14 sites, the most commonly recorded plant species were *Xanthorrhoea preissii* (Balga) and Marri (*Corymbia calophylla*) was recorded from 12 sites. *Agonis flexuosa*, and *Eucalyptus marginata* were recorded from 8 sites, and *Dasypogon bromeliifolius*, *Acacia pulchella*, *Daviesia incrassata*, *Adenanthos meisneri* and *Banksia attenuata* were recorded from 7 sites each.

During this survey, the richest sites were:

- » Site 3: Capel River VCL – 49 taxa
- » Site 2: Woodland on Lot 3096 – 49 taxa, and
- » Site 8: Ludlow River VCL – 42 taxa.

### 3.3.2 Significant Flora

The Priority 3 plant, *Acacia semitrullata*, was observed from four sites during the survey. This is a disturbance response species, and occurs in sand scattered across the southern Swan Coastal Plain.

Although not recorded during this survey, due to season, the Declared Rare Flora, *Caladenia huegelii*, is known from Banksia woodland close to the intersection of the Ore Resource with Warnes/Armstrong Road (Hart, et al., 2001). A spring survey will identify the precise location and number of this species.

No other Declared Rare or Priority Flora species were recorded during this survey. Much of this has to do with the annual nature and/or flowering times of significant flora known to be in this area. A spring survey will enhance the prospect of recording the numbers and location of significant flora in the Study Area.

### 3.3.3 Weeds/Introduced Flora

A number of common introduced weed species were observed during this survey, most of which are annual species generally associated with agricultural practices carried out in Western Australia. Pasture grasses make up 9 of the 33 introduced/weed species recorded from the project area.

Apple of Sodom, *Solanum linnaeanum*, was recorded from the survey area. Four plants of this species were recorded from adjacent to the Ludlow River, upstream of the crossing with Warnes Road. These four plants are present within the designated Resource Area of the Cloverdale Project. Management of these plants is required for either removal and/or prevention of spread (particularly downstream into remnant bushland).

Consultation with landowners indicated the presence of *Emex australis* (Doublegee) within the vicinity of the Capel River. This annual species was recorded only from its seeds during this survey.



Both Apple of Sodom (P1; P4) and Doublegee (P1) are Declared Plants under the Agriculture and Related Resources Protection Act 1976. The ratings (P1, P4) are described below, and are applicable to the Busselton-Capel area:

- » P1: Prohibits movement - The movement of plants or their seeds is prohibited within the State. This prohibits the movement of contaminated machinery and produce including livestock and fodder.
- » P4: Aims to prevent infestation spreading beyond existing boundaries of infestation - The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants:-
  - within 100 metres inside of the boundaries of the infested property
  - within 50 metres of roads and highwater mark on waterways
  - within 50 metres of sheds, stock yards and houses
  - Treatment must be done prior to seed set each year. Properties with less than 2 hectares of infestation must treat the entire infestation.
  - Additional areas may be ordered to be treated

### **3.4 Fauna**

A field survey was carried out by qualified zoologist in conjunction with the flora survey to examine the habitats present and their condition and to carry out an opportunistic survey of the fauna.

A full list of fauna observed can be found in Appendix B. In all, 33 bird species, 3 mammal species, 3 frog species and 4 reptile species were observed. One fish species, *Galaxias occidentalis*, was observed from the Capel River.

#### **3.4.1 Birds**

The avifauna recorded at the Cloverdale Prospect area included one introduced species (Laughing Kookaburra). No Conservation Significant birds were observed, although the Ninox (2003) survey at Yoganup West recorded both the JAMBA protected Rainbow Bee-eater, and Priority 3 Forest Red-tailed Black-Cockatoo.

#### **3.4.2 Mammals**

The common mammal species observed in the Study Area consisted mainly of the Western Grey Kangaroo, and sightings of the introduced European Rabbit. One Red Fox was observed, as well as sightings of these introduced mammals.

The survey was restricted to daylight hours only, minimising the opportunity for observing nocturnal fauna.



### **3.4.3 Amphibia**

The three frog species recorded were all heard along the Capel River. This was the only area of wetland retaining water or moisture of significance during the survey period. It is expected that a follow-up survey would expand these observations following winter rains.

### **3.4.4 Reptiles**

Four reptile species were observed at the Cloverdale Prospect area. All reptiles were observed in the relative cool of the morning, when animals were relatively sluggish. No snake species were sighted or heard during the survey.

## **3.5 Fauna Habitat Assessment**

Where landscapes have been highly modified, such as the Swan Coastal Plain, through a combination of agricultural and mining practices, extensive fauna habitat loss has resulted. As a consequence, any remaining remnants of forest or woodlands are of some importance. Trees, especially mature specimens, provide feeding and breeding habitat, and may be important locations for refuge.

### **3.5.1 Fauna Corridors**

Fauna corridors and habitat linkage are important to allow animals to move between areas of resource availability. Such corridors are important for ground and aerial fauna, providing cover, resources, and linking areas suitable for rest and reproduction.

A habitat corridor is a feature of vegetation that connects at least two patches that were connected historically. As such, corridors are features that help to overcome the effects of habitat fragmentation. Corridors allow the movement of fauna from one place to another, assisting in: the connection of gene pools, enabling recolonisation, and provide habitat. Corridors can be either: line corridors, strip corridors, or “stepping stones”. Stepping stones are isolated patches of vegetation, with the distances between patches small enough for some species to move from one patch to the next, allowing all the patches to be considered as a corridor. Isolated paddock trees can act as stepping stones for some fauna species (particularly birds).

The major fauna corridors in the Cloverdale Prospect area follow the two main river courses: Capel and Ludlow. The Capel River corridor generally provides complete vegetative cover allowing the passage of small vertebrates with reduced predator observation from above.

The Ludlow River corridor is segmented, interspersed with open paddock areas, and mine sites. The remnant vegetation along the Ludlow provides for stepping stones between east and west.

Both rivers provide the major linkages between the coastal wetlands and the forested areas of the Whicher and Darling Scarps to the east.



## 4. Summary

The vegetation and fauna of the Cloverdale project area south of Capel was assessed in early March, 2005 to ascertain its conservation values and to identify any significant constraints to clearing and subsequent mining activity.

The most significant vegetation is present at the northern end of the Study Area on Lot 3096, including marri/jarraah woodland with a condition rating of 2 to 3. Other good quality vegetation (condition rating 2/3) of Banksia woodland was identified along Bibby Road and Warnes Road with Marri/peppermint/*Melaleuca* along a short section of the Ludlow River. None of the vegetation is considered as likely to be threatened.

The Priority 3 flora species, *Acacia semitrullata*, was recorded from four sites. This plant is a disturbance response species but is generally present in low numbers. It is possible that the Declared Rare species, *Caladenia huegelii* is present in Banksia woodland in the survey area. This species has been previously recorded at Warnes/Armstrong Road but can only be identified in October and it is recommended that a search is made at that time.

Two Declared weed species are present in the survey area. These plants, Apple of Sodom and Doublegee, must be controlled under the *Agriculture and Related Resources Protection Act, 1976*.

No fauna of conservation significance was recorded, however, vegetation in the area may be utilised by the Forest Red Tailed Black Cockatoo for feeding. The vegetation along the Capel and Ludlow Rivers provides existing or potential fauna corridors between the Whicher Scarp and the coastal vegetation and such links should be preserved where possible.



## 5. References

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Appendix A  
**Flora List**

Results of Flora Survey



**Table 7 Flora List per Site examined, Cloverdale Prospect**

Family	Genus	Species	Common Name	Status	Site No.													
					1	2	3	4	5	6	7	8	9	10	11	12	13	14
Adiantaceae	Adiantum	aethiopicum	Common Maidenhair				x											
Amaryllidaceae	Amaryllis	belladonna	Easter Lily	*					x									
Anthericaceae	Chamaescilla	corymbosa var. corymbosa	Blue Squill														x	
Anthericaceae	Johnsonia	lupulina	Hooded Lily														x	
Anthericaceae	Laxmannia	sessiliflora ssp. sessiliflora	Nodding Lily											x			x	
Anthericaceae	Laxmannia	minor			x	x							x	x				
Anthericaceae	Thysanotus	manglesianus/patersonii															x	
Anthericaceae	Thysanotus	sp.					x											
Anthericaceae	Thysanotus	sparteus															x	
Anthericaceae	Thysanotus	tenellus															x	
Apiaceae	Centella	asiatica	Pennywort				x											
Apiaceae	Trachymene	pilosa	Native Parsnip														x	
Asteraceae	Arctotheca	calendula	Capeweed	*													x	
Asteraceae	Conyza	albida	Tall Fleabane	*			x					x						
Asteraceae	Cotula	turbinata	Cotula	*													x	
Asteraceae	Hypochaeris	glabra	Flatweed	*	x		x										x	
Asteraceae	Rhodanthe	citrina															x	
Asteraceae	Symphotricum	subulatum	Bushy Starwort	*										x				
Asteraceae	Ursinia	anthemoides	Ursinia	*		x												
Caryophyllaceae	Cerastium	sp.	Chickweed	*													x	



Family	Genus	Species	Common Name	Status	Site No.															
Casuarinaceae	Allocasuarina	humilis	Dwarf Sheoak		x	x								x						
Centrolepidaceae	Centrolepis	drummondiana																		x
Chenopodiaceae	Chenopodium	album	Fat Hen	*				x			x									
Colchicaceae	Burchardia	umbellata	Milkmaids																	x
Crassulaceae	Crassula	sp.	Crassula	*																x
Cyperaceae	Cyathochaeta	equitans																		x
Cyperaceae	Cyperus	?congestus	Dense Flat-sedge	*				x												
Cyperaceae	Isolepis	stellata	Star Club-Rush																	x
Cyperaceae	Lepidosperma	effusum	Spreading Sword-sedge					x						x						
Cyperaceae	Lepidosperma	gracile	Slender Sword-sedge				x	x												
Cyperaceae	Lepidosperma	longitudinale	Pithy Sword-sedge		x	x	x							x		x				x
Cyperaceae	Lepidosperma	squamatum			x															x
Cyperaceae	Lepidosperma	tetraquetrum						x												
Cyperaceae	Mesomelaena	tetragona	Semaphore Sedge		x			x							x	x				
Cyperaceae	Schoenus	curvifolius						x												x
Cyperaceae	Tetraria	octandra	Bog Rush					x												
Dasypogonaceae	Calactesia	cyanea "White"	Blue Tinsel Lily		x															
Dasypogonaceae	Dasypogon	bromeliifolius	Pineapple Bush		x	x					x			x	x			x		x
Dasypogonaceae	Kingia	australis	Kingia							x			x			x	x			
Dasypogonaceae	Lomandra	hermaphrodita																		x
Dasypogonaceae	Lomandra	preissii																		x
Dasypogonaceae	Lomandra	sericea	Silky Mat Rush																	x
Dennstaedtiaceae	Pteridium	esculentum	Bracken					x			x			x						

















Appendix B  
**Fauna List**

Results of Fauna Survey



**Table 8 List of Observed Fauna, Cloverdale Prospect**

<b>Birds</b>						
<b>Family</b>	<b>Genus</b>	<b>Species</b>	<b>Common Name</b>	<b>Status</b>	<b>Cloverdale</b>	<b>Ninox</b>
Casuaridae	Dromaius	novaehollandiae	Emu		x	
Anatidae	Tadorna	tadornoides	Australian Shelduck		x	x
Anatidae	Chenonetta	jubata	Australian Wood Duck		x	x
Anatidae	Anas	gracilis	Grey Teal		x	x
Anatidae	Anas	superciliosa	Pacific Black Duck		x	x
Anatidae	Cygnus	atratus	Black Swan		x	
Ardeidae	Ardea	pacifica	White-necked Heron			x
Ardeidae	Ardea	novaehollandiae	White-faced Heron		x	x
Threskiornithidae	Threskiornis	spiniacollis	Straw-necked Ibis		x	x
Accipitridae	Aquila	audax	Wedge-tailed Eagle		x	
Accipitridae	Haliastur	sphenurus	Whistling Kite			x
Falconidae	Falco	cenchroides	Nankeen (Australian) Kestrel			x
Columbidae	Ocyphaps	lophotes	Crested Pigeon		x	x
Columbidae	Phaps	chalcoptera	Common Bronzewing		x	
Psittacidae	Calyptorhynchus	banksii naso	Forest Red-tailed Black Cockatoo	P3		x
Psittacidae	Platycercus	zonarius	Australian Ringneck		x	x
Psittacidae	Platycercus	spurius	Red-capped Parrot		x	
Psittacidae	Neophema	elegans	Elegant Parrot			x
Podargidae	Podargus	strigoides	Tawny Frogmouth			x





## Birds

Family	Genus	Species	Common Name	Status	Cloverdale	Ninox
Halcyonidae	<i>Dacelo</i>	<i>novaeguineae</i>	Laughing Kookaburra	*	x	x
Halcyonidae	<i>Todiramphus</i>	<i>sanctus</i>	Sacred Kingfisher			x
Meropidae	<i>Merops</i>	<i>ornatus</i>	Rainbow Bee-eater	JAMBA		x
Maluridae	<i>Malurus</i>	<i>splendens</i>	Splendid Fairy-wren		x	x
Pardalotidae	<i>Pardalotus</i>	<i>striatus</i>	Striated Pardalote			x
Petroicidae	<i>Eopsaltria</i>	<i>georgiana</i>	White-breasted Robin		x	
Acanthizidae	<i>Smicromnis</i>	<i>brevirostris</i>	Weebill		x	x
Acanthizidae	<i>Gerygone</i>	<i>fusca</i>	Western Gerygone		x	x
Acanthizidae	<i>Sericornis</i>	<i>frontalis maculatus</i>	White-browed Scrubwren		x	
Acanthizidae	<i>Acanthiza</i>	<i>apicalis</i>	Broad-tailed Thornbill			x
Acanthizidae	<i>Acanthiza</i>	<i>inornata</i>	Western Thornbill			x
Acanthizidae	<i>Acanthiza</i>	<i>chrysorrhoa</i>	Yellow-rumped Thornbill		x	x
Meliphagidae	<i>Lichmera</i>	<i>indistincta</i>	Brown Honeyeater			x
Meliphagidae	<i>Phylidronyris</i>	<i>novaehollandiae</i>	New Holland Honeyeater		x	x
Meliphagidae	<i>Anthochaera</i>	<i>carunculata</i>	Red Wattlebird		x	x
Pachycephalidae	<i>Pachycephala</i>	<i>pectoralis</i>	Golden Whistler			x
Pachycephalidae	<i>Pachycephala</i>	<i>rufiventris</i>	Rufous Whistler			x
Dicruridae	<i>Rhipidura</i>	<i>fuliginosa</i>	Grey Fantail		x	x
Dicruridae	<i>Rhipidura</i>	<i>leucophrys</i>	Willie Wagtail		x	x
Dicruridae	<i>Grallina</i>	<i>cyanoleuca</i>	Magpie-lark		x	x
Campephagidae	<i>Coracina</i>	<i>novaehollandiae</i>	Black-faced Cuckoo-shrike		x	x
Campephagidae	<i>Lalage</i>	<i>tricolor</i>	White-winged Triller			x



### Birds

Family	Genus	Species	Common Name	Status	Cloverdale	Ninox
Artamidae	<i>Artamus</i>	<i>cyanopterus</i>	Dusky Woodswallow		x	x
Cracticidae	<i>Cracticus</i>	<i>torquatus</i>	Grey Butcherbird		x	x
Cracticidae	<i>Cracticus</i>	<i>tibicen</i>	Australian Magpie		x	x
Corvidae	<i>Corvus</i>	<i>coronoides</i>	Australian Raven		x	x
Hirundinidae	<i>Hirundo</i>	<i>neoxena</i>	Welcome Swallow		x	x
Alaudidae	<i>Cincloramphus</i>	<i>mathewsii</i>	Rufous Songlark			x
Zosteropidae	<i>Zosterops</i>	<i>lateralis gouldii</i>	Grey-breasted White-eye		x	x
Motacillidae	<i>Anthus</i>	<i>australis</i>	Richard's Pipit		x	x

### Mammals

Family	Genus	Species	Common Name	Status	Cloverdale	Ninox
Dasyuridae	<i>Phascogale</i>	<i>tapoatafa tapoatafa</i>	Common Wambenger	P3		x
Macropodidae	<i>Macropus</i>	<i>fuliginosus</i>	Western Grey Kangaroo		x	x
Plangeridae	<i>Trichosurus</i>	<i>vulpecula</i>	Common Brushtail Possum			x
Leporidae	<i>Oryctolagus</i>	<i>cuniculus</i>	European Rabbit	*	x	x
Canidae	<i>Vulpes</i>	<i>vulpes</i>	Red Fox	*	x	x

### Amphibia

Family	Genus	Species	Common Name	Status	Cloverdale	Ninox
Myobatrachidae	<i>Crinia</i>	<i>glauerti</i>	Glauert's Froglet		x	
Myobatrachidae	<i>Crinia</i>	<i>insignifera</i>	Sandplain Froglet		x	
Myobatrachidae	<i>Limnodynastes</i>	<i>dorsalis</i>	Pobblebonk		x	



<b>Fish</b>						
<b>Family</b>	<b>Genus</b>	<b>Species</b>	<b>Common Name</b>	<b>Status</b>	<b>Cloverdale</b>	<b>Ninox</b>
Galaxiidae	<i>Galaxias</i>	<i>occidentalis</i>	Western Minnow		x	

<b>Reptiles</b>						
<b>Family</b>	<b>Genus</b>	<b>Species</b>	<b>Common Name</b>	<b>Status</b>	<b>Cloverdale</b>	<b>Ninox</b>
Scincidae	<i>Tiliqua</i>	<i>rugosa</i>	Bobtail		x	
Scincidae	<i>Egernia</i>	<i>luctuosa</i>			x	
Scincidae	<i>Ctenotus</i>	<i>labillardieri</i>			x	
Scincidae	<i>Ctenotus</i>	sp.			x	

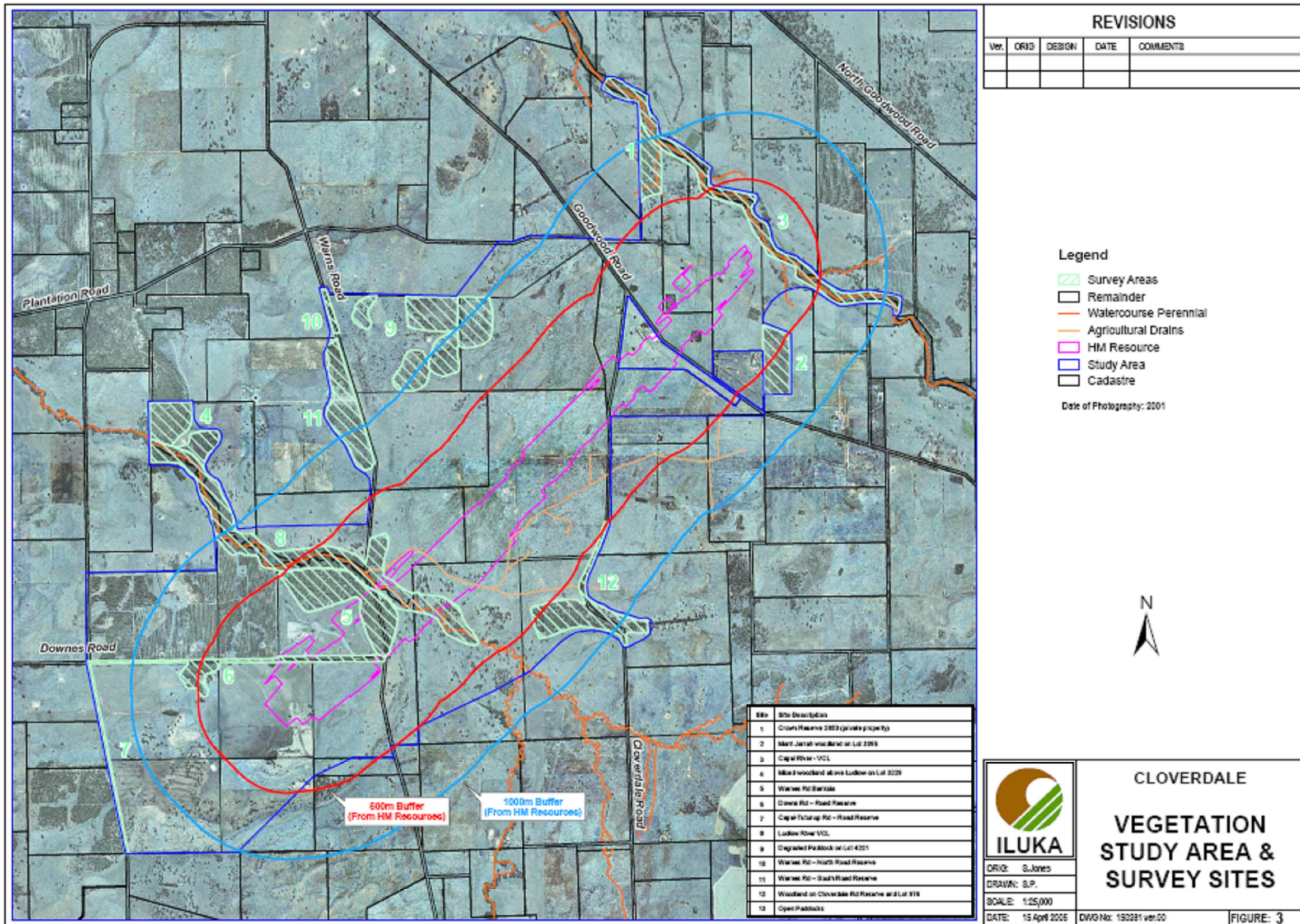


Appendix C

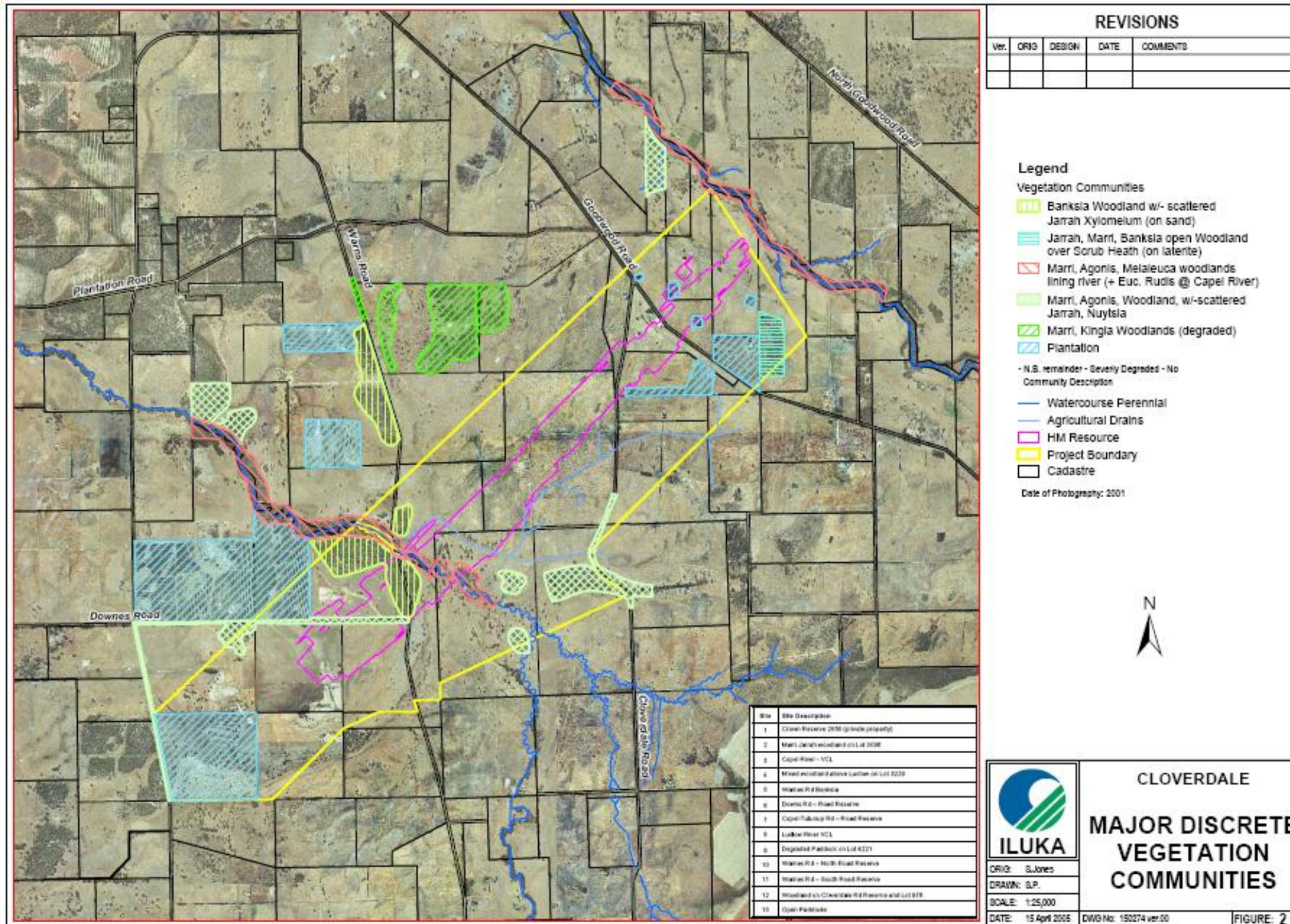
## Maps

Survey Sites, Significant Flora, Vegetation Communities

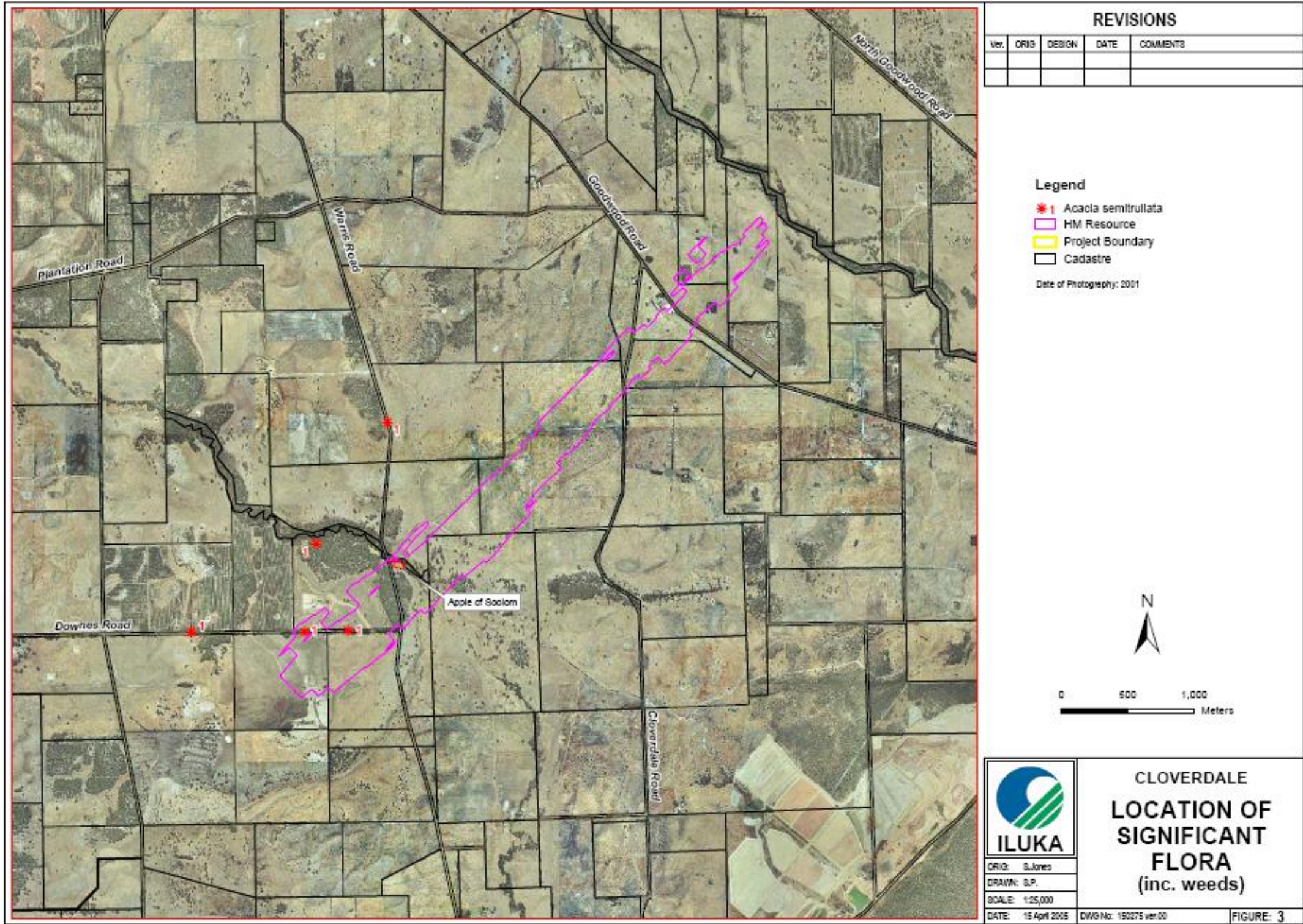














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